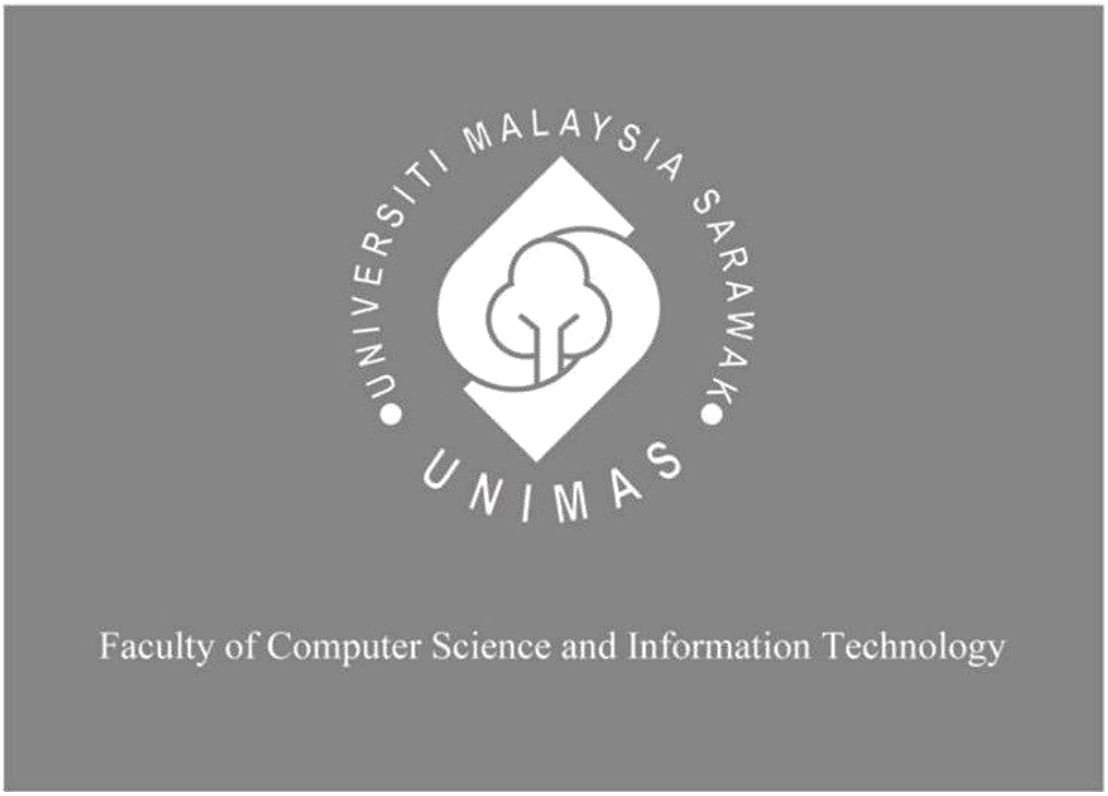

Design and Implementation of Well Integrity Management System (WIMS)

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Bachelor of Computer Science with Honours

(Multimedia Computing)

2019

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This project is submitted in partial fulfilment of the
requirements for the degree of
Bachelor of Computer Science with Honours
(Multimedia Computing)

Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK
2019

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Projek ini merupakan salah satu keperluan untuk

Ijazah Sarjana Muda Sains Komputer dengan Kepujian

(Pengkomputeraan Multimedia)

Fakulti Sains Komputer dan Teknologi Maklumat

UNIVERSITI MALAYSIA SARAWAK

2019

CERTIFICATION OF ORIGINALITY

This is to clarify that the project title "DESIGN AND IMPLEMENTATION OF WELL INTEGRITY MANAGEMENT SYSTEM (WIMS)" is an original work of Rayvienia Jane Rosalim. I have not copied from any other student's work or from any other resources except where due reference or acknowledgement that has been respectively extracted with quotes and citation legitimately.

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Universiti Malaysia Sarawak Date: 2nd May 2019

ACKNOWLEDGEMENT

I would like to express my gratitude to those who have involved directly and indirectly throughout this project development. This project could not have been accomplished without the splendid support and cooperation of all individuals that have encouraged me during the development process in my Final Year Project.

Firstly, greatest appreciation and thanks to my supervisor for Final Year Project, Dr Shapi-ee bin Abd Rahman for continuously motivating and guiding me for completing my Final Year Project. His advices have lighted my way to complete my Final Year Project with confidence.

Next appreciation goes to Dr Nuha binti Loling Othman, who is my examiner for Final Year Project that have guided and given precious advice to complete this project to the best I can. I would also like to mention the Final Year Project coordinator, Professor Dr Wang Yin Chai for the guidelines and coordination throughout the conduction of Final Year Project.

Last but not least, I wish to thank my family and friends especially both of my parents Mr. Rosalim Laab and Mrs. Ervie Atajau for their inspiration, prayers, and for supporting me mentally and physically throughout the project development.

ABSTRACT

Integrity is of vital significance to any Oil and Gas companies when managing the well bores. The availability to have an overview of the well integrity is important at all times as it is essential to economically develop oil and gas resources while preserving the environment. In like manner, Sabah Subsurface (SSS) Sdn. Bhd, an Oil and Gas Company in Sabah that highly concerning on enhancing production running in downhole jobs inside the wellbore, has a current database system that handles the well integrity. However, the current database does not have standard features of managing the well integrity as it uses Microsoft Access as its database platform. Hence, integrity of wells is not centralised and sustained. Well Production and Services (WPS) section in SSS is desirous to migrate the current system to a web-based system called Well Integrity Management System (WIMS). This WIMS is proposed with aims of providing the user for managing well integrity via a web application. The proposed system is capable to directly import the Critical Device Function Test (CDFT) excel file to ease the workload of data manager as well as reducing the error rate and time consumed. Besides, the features of platform mapping of well platforms improves better user interactions. Thus, the proposed system is to redesign the current system to add new features in order to provide a better user-friendly service to Well Production and Services section in SSS.

ABSTRAK

Integriti merupakan kualiti yang amat penting dalam kalangan syarikat pengeluaran minyak dan gas apabila menguruskan produk telaga minyak. Adalah penting untuk dapat melihat gambaran keseluruhan integriti sepanjang masa kerana ia mampu membangunkan sumber pengeluaran minyak dan gas secara ekonomi sambil memelihara alam sekitar. Sabah Subsurface (SSS) Sdn. Bhd merupakan sebuah syarikat pengeluaran minyak dan gas di Sabah amat menitikberatkan kualiti pengeluaran minyak yang dijalankan dalam kerja-kerja di bawah lubang telaga minyak. Syarikat ini mempunyai sistem pangkalan data warisan untuk mengendalikan integriti telaga minyak. Walau bagaimanapun, pangkalan data warisan ini tidak mempunyai ciri-ciri asas untuk mengurus integriti telaga minyak dengan baik kerana ia menggunakan 'Microsoft Access' sebagai platform pangkalan datanya. Oleh itu, integriti sesebuah telaga amat sukar untuk dikekalkan dan diurus secara sistematik. Telaga Pengeluaran dan Perkhidmatan (WPS) di SSS berhasrat untuk memindahkan sistem warisan ke platform yang lebih baharu iaitu dikenali sebagai Sistem Pengurusan Telaga Integriti (WIMS). WIMS ini bertujuan untuk menyediakan servis kepada pengguna untuk mengurus integriti dengan lebih sistematik menerusi aplikasi web. Sistem yang dicadangkan mampu mengimport fail Ujian Fungsi Peranti Kritikal (CDFT) secara automatik untuk memudahkan beban kerja pengurus data serta mengurangkan kadar ralat dan masa yang digunakan. Selain itu, ciri pemetaan geografi sesebuah pelantar minyak mampu meningkatkan interaksi pengguna dengan lebih baik. Oleh itu, sistem yang dicadangkan adalah untuk mengubah reka bentuk sistem warisan melalui penambahan ciri-ciri baharu supaya lebih banyak perkhidmatan disediakan kepada pengguna Telaga Pengeluaran dan Perkhidmatan di SSS.

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CHAPTER 1: INTRODUCTION

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Design and Implementation of Well Integrity Management System (WIMS)

1.2 Background

Well is a boring in the Earth that is designed to bring petroleum oil hydrocarbons to the surface. Usually some natural gas is released along with the oil. It is not deniable that oil and gas are one of the significant raw materials that we need in our daily lives, every day we use hundreds of things that are made from oil or gas. Thus, it is important to ensure a robust exploration and production of oil and gas so that its sustainability is maintained.

Since oil wells can only be managed by the experts of the industry, therefore, a preferred engineering provider in Sabah is responsible to ensure its sustainability. To meet the reasonable level of efficiency and service performance, wells must be well-managed. Well Integrity Management System (WIMS) is designed to provide well integrity assurance by providing safety critical equipment and well barrier info on the go of wells in Sabah Subsurface (SSS) Sdn. Bhd.. In Leeper (1988) it is stated that an advanced automated control technology is a key to achieve improvement of productivity and reduction in investment costs.

WIMS is one of the main projects for Sabah Subsurface (SSS) Sdn. Bhd.. The company has been growing progressively to achieve value creation in the production of oil and gas business with portraying strong capability development via expansion of its operations. Up to date, SSS consists of eight (8) operating fields (oil field and gas field) and three (3)

processing terminals (one Labuan-based and two Kota Kinabalu-based). Engineering section of Well Production and Services is one of the critical sections in Sabah Subsurface Sdn. Bhd. WPS focus on enhancing production running in downhole jobs inside the wellbore and ensure an optimize oil and gas production is achieved.

The company is desirous to migrate the existing WIMS modules which uses Microsoft Access as database to a newer platform. Currently, Well Production and Services Section is using a manual based system which requires the operation to manually input the data in the system. This method is surely time consuming for the employees of Well Production and Services Section.

Therefore, the WPS section plan to develop a database management system called WIMS. The main function of WIMS is it is able to retrieve and transfer the data from an excel file and automatically save the data in the system by just scanning/uploading the file to the main system. WIMS will also be a platform the keep all the information of the well details in Sabah SubSurface Sdn. Bhd.

1.3 Problem Statement

The current system allows the user to track and record the Well Integrity information. However, several issues needed to be addressed to improve the system.

- The current system uses Microsoft Access as database system to keep track of the records.

  The current system is not a web-platform, using Microsoft Access as database is less efficient as only the focal engineer in the company will be able to get accessed to it.

Thus, this issue makes other engineers face difficulties to track the well information when they are at outstation or onshore.

- Time consuming

  Firstly, the CDFT (excel file) that contains all the information about the well is being filled up by the engineer who are at onshore, then the engineer will email the particular CDFT to the focal engineer in company. Since the current system is not a web system, the focal engineer has to manually input the data from the CDFT excel file to their Microsoft Access database. Thus, this issue is time consuming as they have to fill up twice of the data input.

- Data is available but does not been analyse for future job

  The CDFT excel file contains many information, however only some information is being listed in the current system. This issue causes available data to not fully utilise for future job as some details are not saved in the records.

1.4 Aims and Objectives

The main objective of this project is to design and develop a web-based system that have a changeover method from current system to developed web-based platform. Other objectives include:

a) To develop a system that can help users to track Well Integrity via a web application.

b) To enhance features in proposed system by;

   - Allowing system administrator to directly upload an excel file.
   - Providing platform mapping for users to improve efficiency at work.
   - Providing well details, daily progress records, and Wellhead Preventive Maintenance records in the system.

c) To evaluate the usability of the system through user testing.

- Sabah Subsurface Sdn. Bhd. will be the system's client where they will test and verify the functions of the system.

1.5 Scope

- WIMS remains the features and targeted users in the current system where
  a) System Administrator (Focal Engineer) of Well Production and Services is able
     - To control and monitor the overall movement of well onshore that contains the information of well data integrity.
     - To directly upload the excel file to system.
  b) Guest User (Engineers) onshore views well information online
     - Allows user to keep track on safety critical equipment and well barrier info on the go
- WIMS will implement four new features to improve efficiency at work, which are as follows;
  a) Platform mapping for employees to select specific operating fields.
  b) Records of well data integrity in systematic way
  c) Records of overall available well in Sabah
  d) Provide recent, ongoing, and upcoming activities

1.6 Brief Methodology

In Kothari (2011), Methodology can be described as the methods used by developers or researchers to effectively complete development of a project or conduct a research in an organized manner. This methodology is very important as it will act as a guide and roadmap for the developers along their way of implementing the system.

The Software Development Methodology for Well Integrity Management System will be Rapid Application Development (RAD) as this methodology can adaptive to changes in requirement with minimal development time (Shelly, Cashman & Rosenblatt, 2014). The proposed system development moves from requirements planning, user design, construction and cutover of the project, as shown in Figure 1.1.

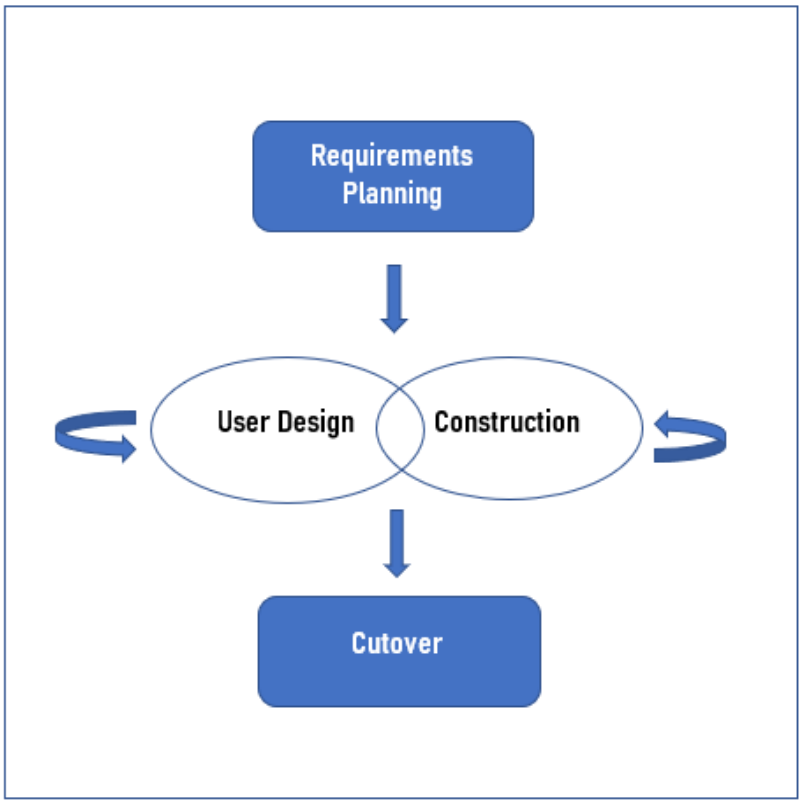

Figure 1.1: Graphical representation of Rapid Application Development

Each phase of development proceeds in strict order. The explanation of each phase's activity is under this section.

Phase 1: Requirements Planning

In requirements planning phase, exploration is begun by querying and gathering information from the policymakers of the company, the engineer of Well Production and Services in this case. Discussion will lead to the production of the requirement list.

In this phase, the specific requirements of the proposed system are defined to achieve the project objectives.

Phase 2: User Design

In this phase, developer communicates with stakeholders to ensure the user requirements and objectives are being met at every step in the design process.

This phase includes three subtasks which are prototype, refine and test. Prototype is designed by developer, users of the proposed system test it. This is seen to be an iterative phase whereby there is need to develop and gain feedback from stakeholder, for instance, the representative from Well Production and Services and FYP supervisor through the demonstrate phase and then refine it accordingly until the results of the refinement is acceptable, only then there will be thorough testing process of the project.

Phase 3: Construction

In this phase, the design phase based on user's requirements is converted into working model. The proposed system is developed using appropriate programming and scripting language such as PHP, MySQL and JavaScript. The prototype is designed and tested to see if it matches the objectives of the development.

Phase 3: Cutover

In this cutover phase, representative from Well Production and Services will perform integration testing to evaluate the usability of the system through user testing, reviews and comments are collected and act as the input of the next iteration until the system is

satisfied by users. A fully integrated system is developed at the end of the stage and user training will be given to users.

1.7 Significance of project

The significance of this project is to design a new system for the users of Well Production and Services that can increase the value of the system to monitor the production of well in modern-user interface via a web browser. There are new features will be implemented into the system, which are platform mapping interface, data import/export, and overall well details in Sabah. In addition, one of the main tasks of this project is to import excel file that can ease the system administrator responsibilities while inputting data into the database to ensure system availability.

1.8 Project Schedule

Figure 1.2 and Figure 1.3 show the proposed project schedule that will be used as a guideline for the progress of Well Integrity Management System.

Gantt chart of Well Integrity Management System (WIMS)

	FYP1 - Well Integrity Management System	**87 days**	**Sun 16/9/18**	**Fri 11/1/19**
	Study and Research about the necessary database management	3 days	Sun 16/9/18	Tue 18/9/18
	Brief Proposal	9 days	Mon 17/9/18	Thu 27/9/18
	Project Proposal	12 days	Thu 4/10/18	Fri 19/10/18
	Chapter 1: Introduction	**6 days**	**Sat 20/10/18**	**Fri 26/10/18**
	Chapter 1:Preparation	5 days	Sat 20/10/18	Thu 25/10/18
	Chapter 1: Submission	1 day	Fri 26/10/18	Fri 26/10/18
	Chapter 2: Literature Review	**16 days**	**Sat 27/10/18**	**Fri 16/11/18**
	Review, journal, and existing system	2 days	Sat 27/10/18	Mon 29/10/18
	Documentation	13 days	Tue 30/10/18	Thu 15/11/18
	Chapter 2: Submission	1 day	Fri 16/11/18	Fri 16/11/18
	Chapter 3: Requirement Analysis and Design	**16 days**	**Mon 19/11/18**	**Sat 8/12/18**
	Requirement collection	4 days	Mon 19/11/18	Thu 22/11/18
	Create DFD, ERD	5 days	Fri 23/11/18	Thu 29/11/18
	Basic design of system	6 days	Fri 30/11/18	Fri 7/12/18
	Chapter 3: Submission	1 day	Sat 8/12/18	Sat 8/12/18
	FYP1 Symposium Preparation	**8 days**	**Mon 10/12/18**	**Wed 19/12/18**
	Final Report Preparation	5 days	Mon 10/12/18	Fri 14/12/18
	Final Report Submission	1 day	Sat 15/12/18	Sat 15/12/18
	Presentation Slide Presentation	1 day	Mon 17/12/18	Mon 17/12/18
	FYP 1 Symposium	2 days	Tue 18/12/18	Wed 19/12/18

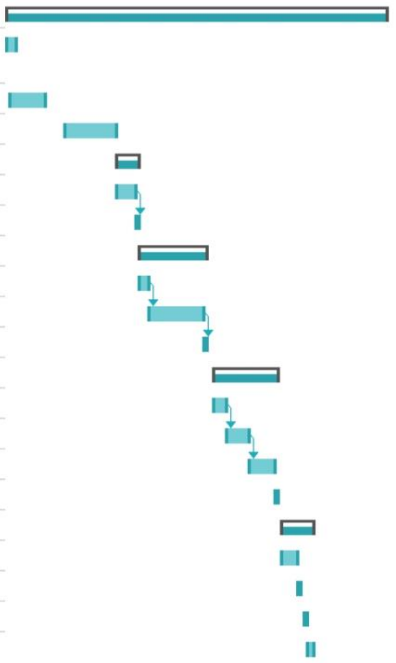

Figure 1.2: Gantt Chart Part A

Gantt chart of Well Integrity Management System (WIMS) - Continue

	FYP1 Report Amendment	**17 days**	**Thu 20/12/18**	**Fri 11/1/19**
	Discussion with supervisor	1 day	Thu 20/12/18	Thu 20/12/18
	Amendment (if any)	15 days	Fri 21/12/18	Thu 10/1/19
	Final Report Submission	1 day	Fri 11/1/19	Fri 11/1/19
	FYP2 - Well Integrity Management System	**93 days**	**Sun 13/1/19**	**Mon 20/5/19**
	Chapter 4: Implementation and Testing	**77 days**	**Sun 13/1/19**	**Sat 27/4/19**
	Gathering the software and hardware requirements	1 day	Sun 13/1/19	Sun 13/1/19
	Create User Interfaces	12 days	Tue 15/1/19	Wed 30/1/19
	Implement system functionalities	42 days	Fri 1/2/19	Sun 31/3/19
	Discussion with supervisor	1 day	Mon 1/4/19	Mon 1/4/19
	Amendment for system functionalities and User Interfaces	5 days	Tue 2/4/19	Mon 8/4/19
	Set up testing data with client and supervisor	7 days	Tue 9/4/19	Wed 17/4/19
	System testing with client and supervisor	1 day	Thu 18/4/19	Thu 18/4/19
	Gather feedbacks from client and supervisor	1 day	Fri 19/4/19	Fri 19/4/19
	Refine system based on client's feedbacks	5 days	Sat 20/4/19	Thu 25/4/19
	System testing with client and supervisor	1 day	Fri 26/4/19	Fri 26/4/19
	User acceptance test	1 day	Sat 27/4/19	Sat 27/4/19
	Chapter 5: Conclusion and Future Works	**17 days**	**Sat 27/4/19**	**Mon 20/5/19**
	Implementation of System	1 day	Sat 27/4/19	Sat 27/4/19
	Discussion with supervisor	1 day	Mon 29/4/19	Mon 29/4/19
	FYP Final Report Submission Draft	2 days	Fri 3/5/19	Sat 4/5/19
	Amendment of FYP2	12 days	Sun 5/5/19	Sun 19/5/19
	FYP Final Report Submission	1 day	Mon 20/5/19	Mon 20/5/19

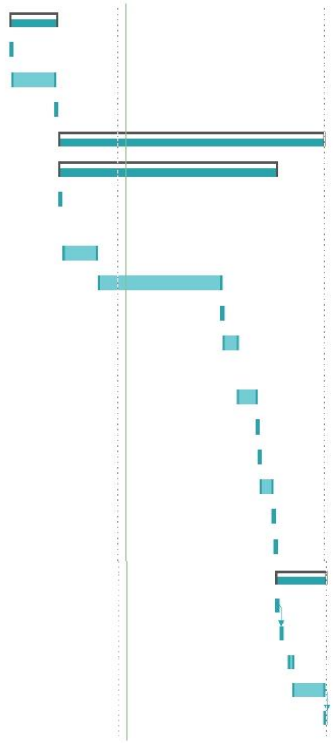

Figure 1.3: Gantt Chart Part B

1.9 Expected Outcome

The main outcome of this project is a working prototype of a system that mainly records the well integrity in Sabah. The proposed system is a changeover method from Microsoft Access database to web-based management system that is capable to directly import/export excel file to system. WIMS should have a user-friendly and attractive interface that allows user to view information regarding the wells in Sabah. With the implementation of platform mapping, it allows the user to track records of specific field. The details of well status would be reported in a way that the engineer team would be able to interpret and keep track hence improving efficiency at work.

1.10 Project Outlines

This paper includes five (5) chapters to describe the design and implementation of WIMS.

Chapter 1: Introduction

Chapter 1 describes the background of the current system of database and stated the needs of enhancement that is to convert the current manual system to newer platform. This chapter is comprehensive of the problem statement, objectives, brief methodology, project significant, project schedule, expected outcome and project outline. This chapter is to give a brief information of what WIMS is about. The problem statement describes the challenges faced by the current system and the objective clarifies the project's goals.

Chapter 2: Literature Review

In this chapter mainly focus on the literature review of related and similar existing systems. The overall review is done based on articles, journals and conference papers. Comparison